

```

library(lpSolveAPI)
b <- make.lp(0,9,verbose = "neutral")
b

## Model name:
##   a linear program with 9 decision variables and 0 constraints

```

Adding Constraints and solving the problem

```

add.constraint(b, c(1,1,1,0,0,0,0,0,0), "<=", 750 )
add.constraint(b, c(0,0,0,1,1,1,0,0,0), "<=", 900)
add.constraint(b, c(0,0,0,0,0,0,1,1,1), "<=", 450)
add.constraint(b, c(20,15,12,0,0,0,0,0,0), "<=", 13000)
add.constraint(b, c(0,0,0,20,15,12,0,0,0), "<=", 12000)
add.constraint(b, c(0,0,0,0,0,0,20,15,12), "<=", 5000)
add.constraint(b, c(1,1,1,0,0,0,0,0,0), "<=", 900)
add.constraint(b, c(0,0,0,1,1,1,0,0,0), "<=", 1200)
add.constraint(b, c(0,0,0,0,0,0,1,1,1), "<=", 750)
add.constraint(b, c(6, 6, 6, -5, -5, -5, 0, 0, 0), "=", 0)
add.constraint(b, c( 3, 3, 3, 0, 0, 0, -5, -5, -5), "=", 0)

set.objfn(b, c(420,360,300,420,360,300,420,360,300))
lp.control(b, sense='max')

## $anti.degen
## [1] "none"
##
## $basis.crash
## [1] "none"
##
## $bb.depthlimit
## [1] -50
##
## $bb.floorfirst
## [1] "automatic"
##
## $bb.rule
## [1] "pseudononint" "greedy"          "dynamic"          "rcostfixing"
##
## $break.at.first
## [1] FALSE
##
## $break.at.value
## [1] 1e+30
##
## $epsilon
##          epsb          epsd          epsel          epsint  epsperturb  epspivot
##          1e-10          1e-09          1e-12          1e-07          1e-05          2e-07
##
## $improve
## [1] "dualfeas" "thetagap"

```

```

##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
## 1e-11 1e-11
##
## $negrage
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex" "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric" "equilibrate" "integers"
##
## $sense
## [1] "maximize"
##
## $simplextype
## [1] "dual" "primal"
##
## $timeout
## [1] 0
##
## $verbose
## [1] "neutral"

b.col <- c("P 1","P 2","P 3","p 4","p 5","p 6","p 7","p 8","p 9")
b.row <- c("Y1l","Y1m","Y1s","Y2l",
"Y2m","Y2s","Y3l","Y3m","Y3s","%C1","%C2")
dimnames(b) <- list(b.row,b.col)

b

## Model name:
## a linear program with 9 decision variables and 11 constraints

```

```

solve(b)

## [1] 0

get.objective(b)

## [1] 696000

get.variables(b)

## [1] 516.6667 177.7778  0.0000  0.0000 666.6667 166.6667  0.0000
0.0000
## [9] 416.6667

```

Question 2:

Reduced Costs

```

get.sensitivity.obj(b)

## $objfrom
## [1] 3.60e+02 3.45e+02 -1.00e+30 -1.00e+30 3.45e+02 2.52e+02 -1.00e+30
## [8] -1.00e+30 2.04e+02
##
## $objtill
## [1] 4.60e+02 4.20e+02 3.24e+02 4.60e+02 4.20e+02 3.24e+02 7.80e+02
4.80e+02
## [9] 1.00e+30

```

Shadow Prices

```

get.sensitivity.rhs(b)

## $duals
## [1] 0 0 0 12 20 60 0 0 0 -12 84 0 0 -24
-40
## [16] 0 0 -360 -120 0
##
## $dualsfrom
## [1] -1.000000e+30 -1.000000e+30 -1.000000e+30 1.041667e+04 1.000000e+04
## [6] 4.800000e+03 -1.000000e+30 -1.000000e+30 -1.000000e+30 -3.333333e+02
## [11] -8.333333e+01 -1.000000e+30 -1.000000e+30 -8.611111e+02 -1.000000e+02
## [16] -1.000000e+30 -1.000000e+30 -5.000000e+01 -1.333333e+02 -1.000000e+30
##
## $dualstill
## [1] 1.000000e+30 1.000000e+30 1.000000e+30 1.388889e+04 1.250000e+04
## [6] 5.400000e+03 1.000000e+30 1.000000e+30 1.000000e+30 1.666667e+02
## [11] 1.666667e+02 1.000000e+30 1.000000e+30 1.111111e+02 2.500000e+02
## [16] 1.000000e+30 1.000000e+30 2.500000e+01 6.666667e+01 1.000000e+30

```

Dual solution

```

get.dual.solution(b)

```

```
## [1] 1 0 0 0 12 20 60 0 0 0 -12 84 0 0
-24
## [16] -40 0 0 -360 -120 0
```

Question 3:

```
Sensitivity<-
data.frame(get.sensitivity.rhs(b)$duals[1:21],get.sensitivity.rhs(b)$dualsfrom[1:21],get.sensitivity.rhs(b)$dualstill[1:21])
names(Sensitivity)<-c("Price","low","High")
Sensitivity
```

##	Price	low	High
## 1	0	-1.000000e+30	1.000000e+30
## 2	0	-1.000000e+30	1.000000e+30
## 3	0	-1.000000e+30	1.000000e+30
## 4	12	1.041667e+04	1.388889e+04
## 5	20	1.000000e+04	1.250000e+04
## 6	60	4.800000e+03	5.400000e+03
## 7	0	-1.000000e+30	1.000000e+30
## 8	0	-1.000000e+30	1.000000e+30
## 9	0	-1.000000e+30	1.000000e+30
## 10	-12	-3.333333e+02	1.666667e+02
## 11	84	-8.333333e+01	1.666667e+02
## 12	0	-1.000000e+30	1.000000e+30
## 13	0	-1.000000e+30	1.000000e+30
## 14	-24	-8.611111e+02	1.111111e+02
## 15	-40	-1.000000e+02	2.500000e+02
## 16	0	-1.000000e+30	1.000000e+30
## 17	0	-1.000000e+30	1.000000e+30
## 18	-360	-5.000000e+01	2.500000e+01
## 19	-120	-1.333333e+02	6.666667e+01
## 20	0	-1.000000e+30	1.000000e+30
## 21	NA	NA	NA

Question 4:

```
objfun = c(420,420,420,360,360,360,300,300,300)
lp.control(b, sense = 'max')
```

```
## $anti.degen
## [1] "none"
##
## $basis.crash
## [1] "none"
##
## $bb.depthlimit
## [1] -50
##
## $bb.floorfirst
## [1] "automatic"
```

```

##
## $bb.rule
## [1] "pseudononint" "greedy"          "dynamic"          "rcostfixing"
##
## $break.at.first
## [1] FALSE
##
## $break.at.value
## [1] 1e+30
##
## $epsilon
##      epsb      epsd      epsel      epsint  epsperturb  epspivot
##      1e-10      1e-09      1e-12      1e-07      1e-05      2e-07
##
## $improve
## [1] "dualfeas" "thetagap"
##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
##      1e-11      1e-11
##
## $negrange
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex"      "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric"  "equilibrate" "integers"
##
## $sense
## [1] "maximize"
##
## $simplextype
## [1] "dual"      "primal"

```

```

##
## $timeout
## [1] 0
##
## $verbose
## [1] "neutral"

lpDual <- make.lp(0,12)
set.objfn(lpDual, c(750,900,450,13000,12000,5000,900,1200,750,0,0,0))

lp.control(lpDual,sense='min',simplextype="dual")

## $anti.degen
## [1] "fixedvars" "stalling"
##
## $basis.crash
## [1] "none"
##
## $bb.depthlimit
## [1] -50
##
## $bb.floorfirst
## [1] "automatic"
##
## $bb.rule
## [1] "pseudononint" "greedy"          "dynamic"          "rcostfixing"
##
## $break.at.first
## [1] FALSE
##
## $break.at.value
## [1] -1e+30
##
## $epsilon
##      epsb      epsd      epsel      epsint  epsperturb  epspivot
##      1e-10      1e-09      1e-12      1e-07      1e-05      2e-07
##
## $improve
## [1] "dualfeas" "thetagap"
##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
##      1e-11      1e-11
##

```

```

## $negrange
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex"      "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric"    "equilibrate" "integers"
##
## $sense
## [1] "minimize"
##
## $simplextype
## [1] "dual" "dual"
##
## $timeout
## [1] 0
##
## $verbose
## [1] "neutral"

add.constraint(lpDual ,c(1,0,0,20,0,0,1,0,0,900,0,450), ">=", 420)
add.constraint(lpDual ,c(0,1,0,0,20,0,1,0,0,-750,450,0), ">=", 420)
add.constraint(lpDual ,c(0,0,1,0,0,20,1,0,0,0,-900,-750), ">=", 420)

add.constraint(lpDual ,c(1,0,0,15,0,0,0,1,0,900,0,450), ">=", 360)
add.constraint(lpDual ,c(0,1,0,0,15,0,0,1,0,-750,450,0), ">=", 360)
add.constraint(lpDual ,c(0,0,1,0,0,15,0,1,0,0,-900,-750), ">=", 360)

add.constraint(lpDual ,c(1,0,0,12,0,0,0,0,1,900,0,450), ">=", 300)
add.constraint(lpDual ,c(0,1,0,0,12,0,0,0,1,-750,450,0), ">=", 300)
add.constraint(lpDual ,c(0,0,1,0,0,12,0,0,1,0,-900,-750), ">=", 300)

solve(lpDual)

## [1] 0

get.objective(lpDual)

## [1] 696000

```

```
get.variables(lpDual)
```

```
## [1] 0.0000000 0.0000000 0.0000000 12.0000000 20.0000000 60.0000000
```

```
## [7] 0.0000000 0.0000000 0.0000000 0.2000000 0.4666667 0.0000000
```

```
get.constraints(lpDual)
```

```
## [1] 420 460 780 360 360 480 324 300 300
```